

## Smart Lighting Demos

The following are demos and hands-on activities to provide additional background for smart lighting.

### Cypress CapSense EZ Color CY 3263N Starter Demo Kit



Cypress Semiconductor's CY3269N Lighting Starter Demonstration Kit leverages two key Cypress technologies for development of intelligent LED lighting fixtures. At the simple touch of a finger, users can illuminate anything from an entire room to a large architectural lighting display with warm, neutral, or cool white light of variable color temperature. Users can create rich and vibrant colored light to set moods, accents, and customize the overall feel of any venue with little effort. The CY3269N Lighting Starter Demonstration Kit showcases two world-leading Cypress technologies: EZ-Color and



CapSense, which enable tunable white light control, color mixing, and capacitive touch sensing. More information at <http://www.cypress.com/?rID=14296>

This device is quite durable, so it is generally passed around the classroom so that students, teachers, parents, etc. can experience this excellent example of a state-of-the art control system for lighting that involves the use of standard measures of color index.



The colorBUG™ is an ingenious handheld device for testing color and illuminance in studio, architectural and theatre applications.

Perfect for lighting designers, photographers and producers, colorBUG is no larger than a typical mobile phone and comes with applications that allow you to determine output with greater precision than ever before. What's more, colorBUG's exclusive software allows you to share data with your iPhone or iPod touch.



**Video of colorBUG working with iPhone**

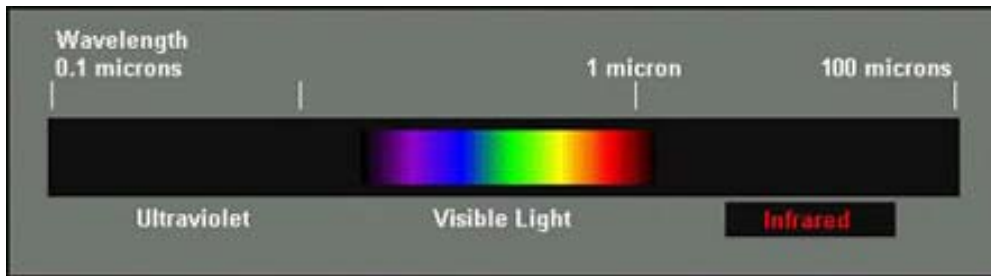
There's simply nothing more convenient or clever for creating the perfect color and lighting environment. The colorBUG makes storing and analyzing data a snap. With its wireless capabilities, colorBUG communicates directly to your iPhone or iPod touch -- without the need for a PC or cables.

More information on the colorBUG is found at <http://www.oceanoptics.com/products/colorbug.asp>

To see the power of the colorBUG, a variety of LEDs can be used to generate colors that register throughout the range of parameters that can be sensed.



**Optical Signals: Using light to control the operation of televisions, etc. and to send music through the air.**



**Infrared Light – What is Infrared Light?** It is light beyond red that is not visible to us. IR is given off by hot things. (There is also ultraviolet light that is beyond blue. UV light gives us sun tans.) What do we know about IR light?

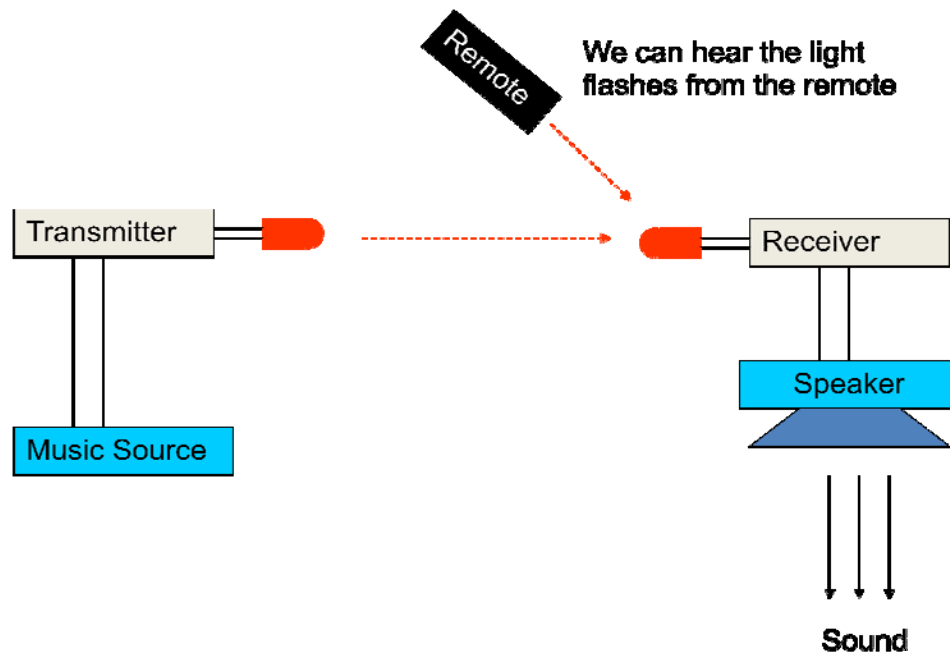
- Cannot be seen by humans
- Can be seen by digital camera
- Remote control sends IR light flashes to TV or any other device it is to control



Pushing a button on a remote control causes a particular sequence of light flashes to be sent to the TV or other device that is being controlled. The flashes are like a secret code that only the TV can understand and that we cannot see.

1. Using any available remote control device and a video camera, aim the remote at the camera and observe the light flashes. Can you tell the difference between the flashes sent by different buttons? (Usually not – only the main flash can be seen. The individual flashes occur too fast to be seen by humans but the TV can tell the difference.)
2. Using the same remote control device, aim the remote at the receiver circuit for the audio transmitter and receiver combination (diagram on the next page). The device that receives the IR signal is a photo diode (it looks like an LED). You should be able to hear the pulses of light given off by the remote. Can you describe what they sound like?
3. Finally, download the smaller of the two files found at <http://hibp.ecse.rpi.edu/~connor/SmartPowerandLight/Audio/> which is a recording of the sounds produced by the TVBGone remote control which can shut off any TV sold in North America. Once you get that working, you can download the longer file, which has the complete signal from the remote. Now you can listen to this signal and watch it on the Mobile Studio. What kind of a structure do you see to the signal? Can you see how it is able to send coded messages to electronic devices like TV sets?





4. In the last step, you have tested the receiver. If you detected the sound produced by the remote, your receiver is working. Now you are to set up the music source and transmitter. Using a music source like an iPod or the audio output from the computer, connect the input cable for the transmitter to the music source. Making sure that the LED on the transmitter is pointing directly at the photo diode receiver (looks like an LED), turn on the music signal from the music source. You should be able to hear the music from the speaker connected to the receiver.
  - a. Block the light from the transmitter to the receiver. The sound from the speaker should stop.
  - b. Move the transmitter and receiver apart. The sound should become weaker.
  - c. Aim the transmitter so it does not send a signal to the receiver. The sound should go away.
  - d. Use the optical fiber to direct the light from the transmitter to the receiver. That is, place one end of the fiber by the transmitter LED and the other end by the photodetector. You should be able to hear the music again.
  - e. Re-align the transmitter and receiver and cover the entire experiment (transmitter and receiver) with some kind of material that blocks the background light from the room or turn the room lights off. The sound should become stronger. This is because the photo diode senses the increase in light due to the signal from the transmitter. If the room is too bright, it has a hard time seeing the light.

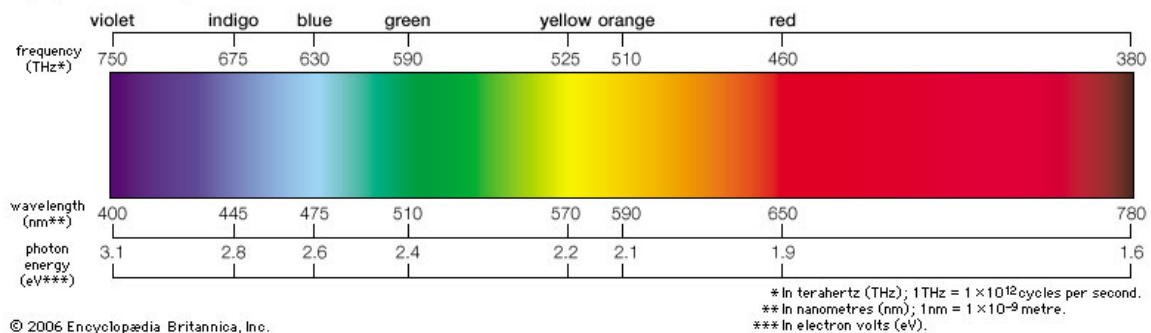


**Other Sources of Light:** Observing the colors that make up light

Light is made up of all the colors of the rainbow from blue to red. To be able to see the individual colors that make up sunlight, for example, we can use a simple device called a spectroscope. In the picture below, the spectroscope looks like a very small telescope. However, unlike a telescope, it has a small slit at one end that separates the colors into a display that looks like the visible spectrum below.



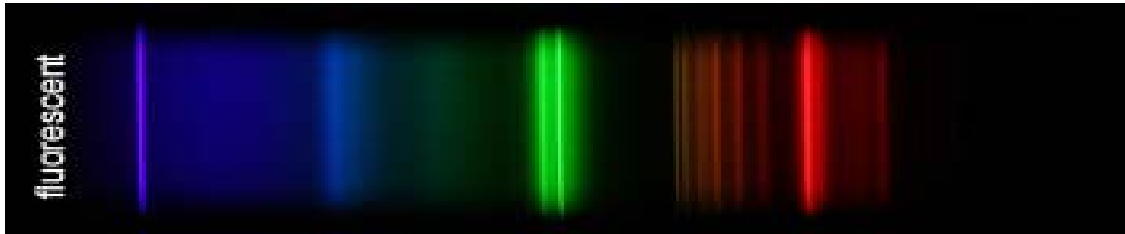
Light, the visible spectrum



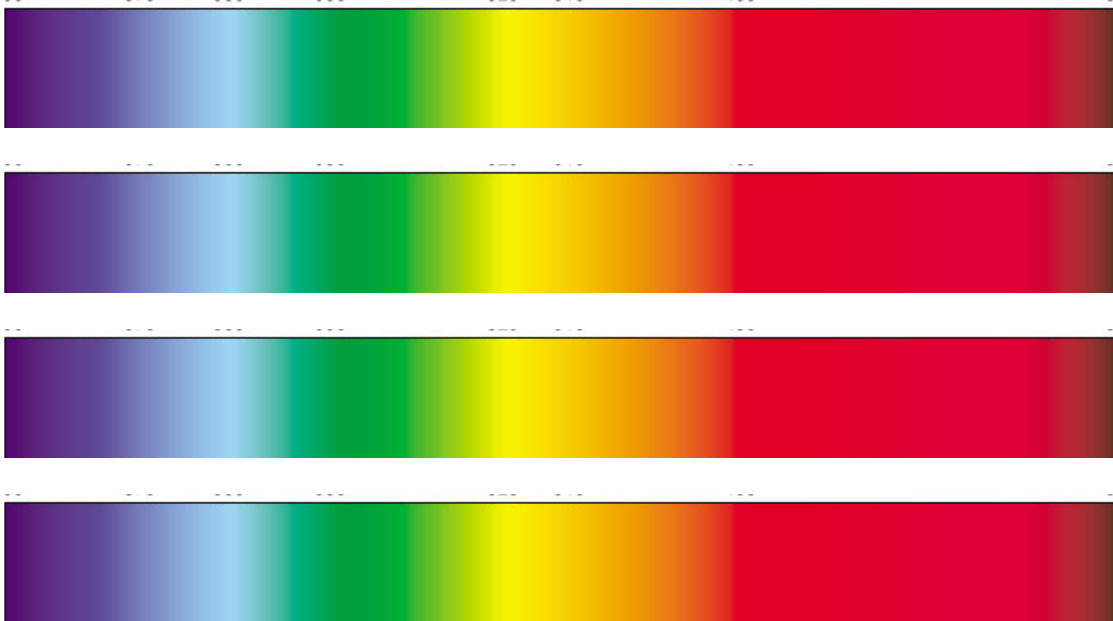
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1. Before we use the spectroscope to look at the kind of light sources made by humans, we should first look at the light from the sun. Go to the nearest window and look out the window through the spectroscope. You should observe something like the picture above (just the colors, without all of the numbers).

- Next, observe several artificial light sources – fluorescent lamps, the light from a computer monitor, light from an LED. Note that the light you observe will look different than sunlight because there are bright lines that stand out in the spectrum. An example is shown below, where a type of fluorescent lamp is seen to have many bright lines. The lamps in the classroom will probably not produce this same pattern.



Observe at least two different light sources in the classroom and then (if you have time) show where you observe the brightest lines by sketching them on the spectra below. If possible, it is a good idea to turn off most other light sources in the room and to have both members of your group observe the light pattern before you sketch it.

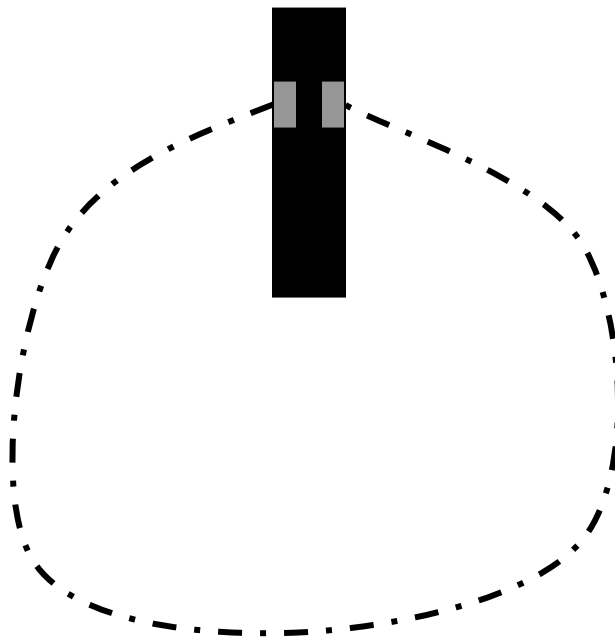


## Light Saber – A discharge lamp that looks like the light saber from Star Wars

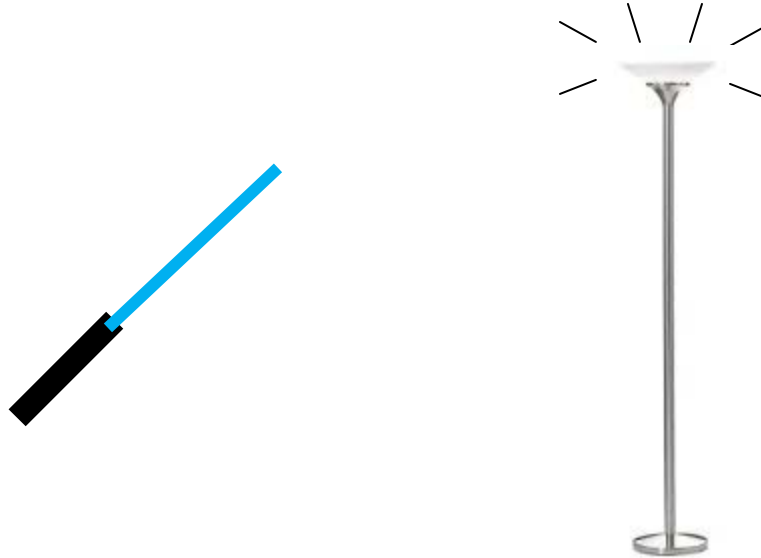
In this device, a light beam is caused to move up a glass tube when the person holding the handle connects the two metal contacts with their thumb or finger



To make this more interesting, and to show that we are all good electrical conductors, each group of six will all hold hands and form a circle with the people at the end each making contact with one of the metal contacts. The length of the light beam is determined by how good the contact is, so having many people in the loop will probably make the beam rather short.



Each student should, thus, try to turn the beam on by themselves and then see if it is longer or shorter. The red beam is neon and the blue beam is argon. Once the beam is as bright as possible, it can be observed through the spectroscope.

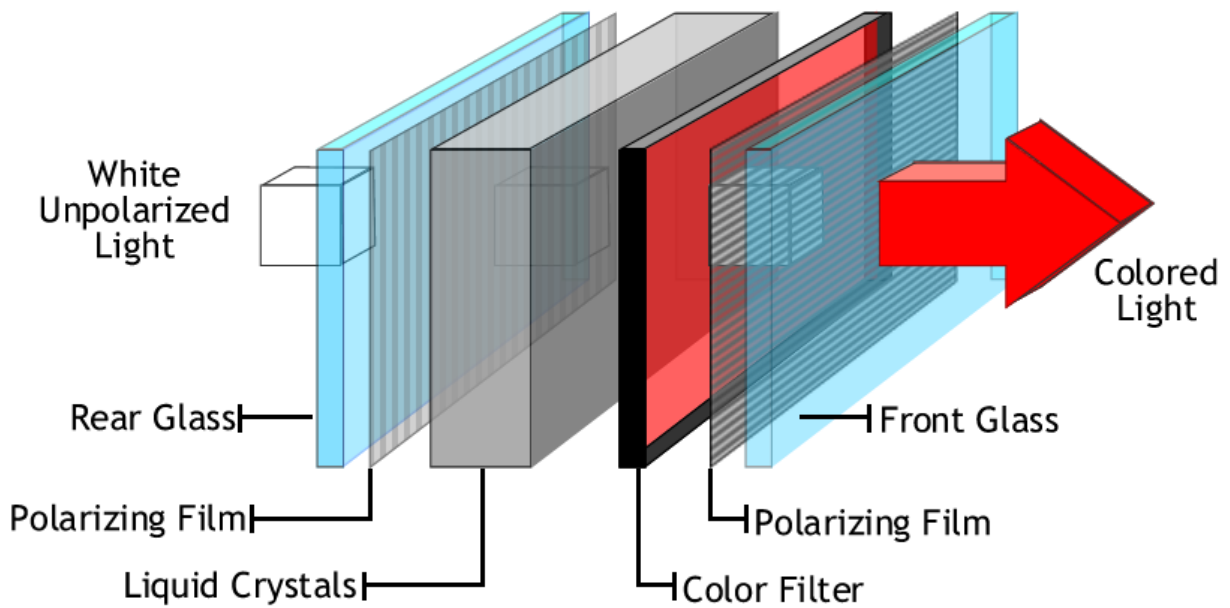


Bring the light saber close to the floor lamp without touching it. About one meter of separation is good. Turn on the light saber and you should also see the floor lamp turn on. This happens because the lamp is electrically very noisy and the floor lamp is a touch lamp. Touch lamps turn on when you touch them because you are acting like an antenna and you pick up electrical noise from the air. To act like an antenna, you must be a conductor, but we have already shown that we are conductors by holding hands and turning the light saber on.

Extra Activity – To see what kind of a conductor you are, use the DMM to measure your resistance. Hold the tips of the mini-grabber connectors between your thumb and index finger on each hand. Write down the value of the resistance of the members of your group.



**Flat Panel Displays – How polarized light allows us to make Liquid Crystal Displays Work.**



LCD displays use light polarizers like the ones we use for sunglasses and 3D displays to turn small dots of colored light on and off. To see that there is a polarizer in such a display, place a polarizing filter over a flat panel display and rotate it until the image goes away. Also use two filters to see the same effect.

Describe what you observe when you place the polarizing filter over the LCD display on the computer you are using. You will have to rotate the filter. Discuss the operation of LCD displays in your group and with one of the ERC students.